

DETAILED ACTION

Status

Claims 1-28 are pending in the application.

Claims 9-28 are directed towards non-elected inventions, and are withdrawn from consideration due to a previous restriction requirement.

Claims 1-8 are presented for examination.

Previous Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-6 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Takada et al in their publication in the Journal of Sol-Gel Science and Technology, titled “Control of Particle Size Distribution of CdS quantum Dots in Gel Matrix”.

Takada teaches a composition of matter that is essentially Cadmium Sulfide quantum dots dispersed throughout a Silica glass, which was acquired through the sol-gel method.

Regarding Claim 1,6 and 8: Takada teaches a phosphor made of CdS quantum dots (semiconductor superfine particles) dispersed within a solid silicon matrix. The phosphoring solid is made through a sol-gel method and where the gel is dried and heat

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treated, followed by flowing hydrogen sulfide over the dried gel. The doping of the glass with CdS was done from 3 wt% CdS to 20 wt% CdS; however, the greatest amount of data is given for those compositions having 7 or 8 wt% CdS. In Figure 7, on page 131 of the publication, the particle size distribution of both CdS in a pure silica gel and in a sodium borosilicate glass. In the gel containing 7 wt% CdS, it is noted that the median particle diameter is 3.0 nm. From this data, the amount of CdS was converted from wt% to mol/l using the given average particle size. These calculations can be seen on the following page, but in brief it was found that 7 wt% CdS in the form **of 3nm particles** has a molality of **3.9E-3 M/l**. This figure falls within the ranges recited in both claims 1 and 8. Thus, the physical composition of the phosphoring composite is exactly the same as the invention, and for this reason the 3% quantum fluorescence yield would be inherent within Takada's teaching, even though not expressly stated.

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Des. of mass of 1 L
of 7 wt % CdS composite

Density CdS $\rightarrow 4.82 \text{ g/cm}^3$

Density $\text{SiO}_2 \rightarrow 2.203 \text{ g/cm}^3$

$$\frac{1}{4.82} \rightarrow .2079 \frac{\text{cm}^3}{\text{g}}$$

$$\frac{1}{2.203} = .454 \frac{\text{cm}^3}{\text{g}}$$

$$.454 \frac{\text{cm}^3}{\text{g}} (\% \text{SiO}_2)(x) + .2079 (\% \text{CdS})(x) = 1000 \text{ cm}^3$$

$$.454 (.93)(x) + .2079 (.07)(x) = 1000 \text{ cm}^3$$

$$4367.8 = 1000$$

$$x = 1000 \text{ cm}^3 \left(\frac{1}{4367.8} \text{ cm}^3 \right)$$

$$x = 2289.4 \text{ g}$$

mass of 7% CdS

$$2289.4 (.07) \rightarrow 160.23 \text{ g}$$

particles in 160.23 g of CdS

$$\frac{160.23}{6.8 \cdot 10^{-20}} = 2.396 \cdot 10^{20}$$

$$N_A \rightarrow 6.022 \cdot 10^{23}$$

$$\frac{2.396 \cdot 10^{20}}{6.022 \cdot 10^{23}} = .0039 \frac{\text{mol CdS}}{\text{L}} = 3.9 \cdot 10^{-3} \frac{\text{M}}{\text{L}}$$

mass of 3 nm
CdS particle (see Fig 7)

$$\frac{4}{3} \pi r^3 \rho$$

$$\frac{4}{3} \pi (1.5)^3 (4.82) \cdot 10^{-21} \left(\frac{\text{g}}{\text{cm}^3} \right) = 6.8 \cdot 10^{-20} \text{ g}$$

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Regarding Claim 2-5: The method of making the phosphor composition of Takada is described in detail on pages 124-126, where the method is a sol-gel process using Cadmium Acetate, tetraethoxysilane (TES), and 3-aminopropyltriethoxysilane(APS). Both APS and TES are organoalkoxysilanes falling under the language of claim 3; however APS falls under the general formula I of Claim 4, where X in the formula is $\text{H}_2\text{NC}_3\text{H}_6$, $n=1$, and $m=3$. After the silica gel doped with cadmium oxide is heated, the cadmium in the composite will not precipitate out of the sol-gel, due to the fact that it remains anchored in the composite because of the APS. After drying, hydrogen sulfide is flowed over the composition and the CdO is converted into CdS. After this process is completed a “uniform and homogeneously dispersed CdO and CdS particles with concentration up to 13wt% have been prepared” in a silica gel. Uniform and homogeneous dispersion is essentially the same as monodispersion.

Previous Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

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2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).
6. Claims 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takada et al in their publication in the Journal of Sol-Gel Science and Technology, titled "Control of Particle Size Distribution of CdS quantum Dots in Gel Matrix" as applied to claim 1 above, and further in view of Chia et in their publication in SPIE, titled "Cadmium Telluride quantum dot-doped glass by the sol-gel technique".

Takada teaches a method of making a cadmium sulfide doped silica gel through a sol gel process using APS, TES, and cadmium acetate. This gel has the recited concentration of CdS (or semiconductor superfine particles) as recited in claims 1 and 8 and upon further treatment. After gellation, drying and a firing process, hydrogen sulfide is flowed over the gel to exchange the oxygen atoms

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in cadmium oxide for sulfur, creating cadmium sulfide. The byproducts of this reaction are the cadmium sulfide, which remains in the gel, and water.

Takada does not teach a phosphor comprising a silica gel with cadmium telluride superfine particles; however, Chia (of the same research group at UCLA as Takada) teaches the creation of cadmium telluride doped silica gels, which are made by substantially the same process as those of Takada. In this process the CdO in the gel is converted to CdTe by flowing sodium telluride in methyl alcohol over the gel. This causes the Te ion to exchange with the Oxygen in Cadmium Oxide, which creates CdTe and Soda in methanol.

This process could be combined with that of Takada simply by using a liquid flow of sodium telluride in place of the gaseous flow of cadmium sulfide in Takada. Both reactions occur by generally the same mechanism, where an oxygen ion is exchanged for a chalcogenide. It would be obvious to import the CdTe into the sol gel of Takada, due to the fact that Takada uses the functionalized APS silane molecule, which he states is useful in anchoring the Cadmium metal ions within the gel to prevent precipitation and agglomeration. These same cadmium metal ions are those, which form CdO particles, which are then converted into CdS or CdTe. As the same Cd doped silica gel would be used the product of this combination would have substantially the same CdTe particle size and concentration as that of Takada's teachings.

Furthermore, the claim language "obtainable by adding a surfactant to an aqueous solution of cadmium perchlorate, adding hydrogen telluride or sodium hydrogen telluride, and then refluxing the mixture" can not be given patentable weight in this situation. This a statement defining a product by the process from which it is made, and the product of the claims and that of Takada in view of Chia is substantially the same, giving a well dispersed CdTe in a silica gel. The differences in the two processes is thus insignificant, since both obtain the same result. Regardless, the two processes are extremely similar and the only notable difference between the two is the fact that the cadmium salt in the instant claims is introduced in the form of CdCl₂, where Takada in view of Chia would use cadmium acetate. Both of these are well known cadmium salts and are interchangeable. Furthermore, Takada teaches the use of APS as a silane able to disperse Cadmium and prevent it from agglomerating and precipitating.

Response to Arguments

7. Applicant's arguments filed 7/28/2008 have been fully considered but they are not persuasive. Applicant argues that the composition of Takada does not emit light based on the fact that nonlinear optical properties are difficult to detect if the material also fluoresces. This argument is fundamentally flawed in that it does not appreciate that the NLO properties stated by Takada have absolutely nothing do with changing the

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light-traveling direction as stated by the applicant. The three NLO properties that Takada mentions are optical bistability, self-phase modulation and phase conjugation. All of these NLO properties are actually based on the Kerr effect, which is a phenomena based on the **change in refractive index** of an NLO material based on the intensity of light. Furthermore, the applicant's assertion that the mere fact that a material has the **ability** to fluorescence of a material would somehow impede the testing of a Kerr effect and the electro-optical properties of a glass is misguided. Testing a fluorescent material for NLO properties does not necessitate using the same wavelength of light as would excite the material and cause it to fluoresce (which for CdS would be somewhere in the VUV band). Further, applicant later states that similar glass was produced by the applicants and it produced little light and has a yield less than 1%. Thus the statement that similar glass produces little light and an NLO glass can produce no light, fundamentally contradict one another.

8. For these reasons the arguments directed towards the NLO properties of the material are not convincing. Applicant also argues that their composition emits light better than Takada's based on the fact that it utilizes surface passivation based on a surfactant. As a surfactant for the CdO, Takada uses functional alkoxysilanes as seen on page 126 in the section titled results and discussion. These are added in addition to the TEOS. This ligand interacts with the CdO in the precursor and enhances dispersion within the matrix, and would thus also be associated with the CdS after heat treatment since the CdO is converted to CdS. Since this ligand would complex with the surface it

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would also have effects on the surface defects of the CdO and by reference to the final CdS.

9. Overall the arguments pertaining to the quantum yield are unconvincing as they also contain no scientific evidence and only broad general statements. Attorney arguments cannot take the place of evidence in regards to the inoperability of the prior art. See MPEP 716.01C. For these reasons, the rejections put forth are maintained

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E. Hoban whose telephone number is (571) 270-3585. The examiner can normally be reached on Monday - Friday from 7:30 AM to 5 PM EST.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jerry Lorengo can be reached on (571) 272-1233. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jerry A Lorengo/
Supervisory Patent Examiner, Art Unit 1793

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